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Attn: Harbor Comments
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Re: Comments on Behalf of FMC Corporation on the Proposed Plan and Draft Final Feasibility Study Report for the Portland Harbor Superfund Site

These comments are submitted on behalf of FMC Corporation (FMC) with respect to the Superfund Proposed Plan and Draft Final Feasibility Study (FS) Report for the Portland Harbor Superfund Site (Portland Harbor or the Site) issued on June 8, 2016 by Region 10 of the United States Environmental Protection Agency (EPA).

FMC is limiting its comments to three issues fundamental to EPA's delineation of Sediment Management Areas (SMAs) at the Site. These issues impact the technical basis for the remedial alternatives developed and evaluated in the FS Report and Proposed Plan, including EPA's evaluation of their relative cost-effectiveness, and the technical and regulatory basis for EPA's proposed selected alternative. As presented in more detail later in these comments; these three issues are the following:

1. Inappropriate development of a Principal Threat Waste (PTW) sediment concentration threshold based on an indirect exposure pathway (fish consumption), and application of a flawed Food Web Model (FWM), resulting in a low-biased and technically unsupportable PTW threshold for PCBs. The largest impact associated with EPA's development and application of a low-biased PTW threshold is on the size of delineated Sediment Management Areas (SMAs) and corresponding volumes to be dredged and/or areas to be capped. Clearly this fundamentally affects the basis of the proposed remedy and the validity of EPA's corresponding remedial cost estimate. Given the significance of these impacts, EPA should thoroughly review both these comments and FMC's attached FWM Report (FMC, 2016), and correct the PTW threshold it has assigned to PCBs in sediments.

2. Development of PTW threshold and remedial action level (RAL) contours by separating near-shore sediment sample data from navigation channel sediment sample data. This results in the

inappropriate delineation of SMA boundaries and consequently calls into question EPA's estimates of dredge volumes, areas to be capped and, ultimately, the costs of the remedial alternatives and proposed selected remedy set forth in the FS Report and Proposed Plan.

3. Inappropriate development of dredge volume estimates using sub-surface sediment composite sampling data. The assigned locations of these composite samples are not representative of the actual locations where the sample increments were obtained. Consequently, substantial uncertainty is introduced into EPA's estimates of dredge volumes and associated costs, which are essential elements of alternatives evaluation and remedy selection under the NCP.

Together these three issues, discussed in greater detail below, demonstrate a lack of technical support for the PTW threshold, SMA contouring and the dredge volume determinations EPA has made. These are fundamental parameters for what EPA has proposed as the selected remedy. EPA must correct and clarify its technical support for these parameters to meet NCP requirements governing alternatives identification, alternatives evaluation, and remedy selection.

1) A mechanistic Food Web Model developed as a component of the Remedial Investigation (RI Mechanistic Model), and based on the work of Arnot and Gobas (2004), was inappropriately applied to develop a PTW sediment concentration threshold for Total PCBs. Furthermore, flaws within the RI Mechanistic Model have resulted in calculation of a low-biased PTW concentration threshold.

As a starting point, EPA has inappropriately relied on the RI Mechanistic Model (Windward, 2015) to define a Principal Threat Waste (PTW) sediment concentration threshold for PCBs (and several other contaminants). EPA guidance defines PTW as a "source material" that "acts as a source for direct exposure." (EPA 1991) (underlining added). The RI Mechanistic Model, in contrast, is used in the evaluation of indirect human exposure through the fish consumption exposure pathway. It is erroneous to use the RI Mechanistic Model to designate PTW levels.

Even if it were appropriate to use the RI Mechanistic Model for purposes of establishing PTW levels, EPA has misapplied it here. EPA has chosen to apply the PTW concentration thresholds it has developed for the fish consumption exposure pathway on a point-by-point basis to identify PTW "source materials." This application is contrary to the assumed exposure area in the RI Mechanistic Report and is therefore inappropriate and incorrect. Most fish have wide home ranges and, consequently, their exposure will not be restricted to locations within the study area where sediment concentrations exceed the PTW threshold. Finally, the PTW threshold concentration is calculated under the inappropriate assumption that a subsistence fisher will, throughout his/her lifetime, exclusively consume fish from Portland Harbor that have only been exposed to sediments containing the PTW threshold concentration. Clearly, this last

assumption adds yet another layer of implausible conservatism to EPA's misguided approach to defining a PTW threshold in sediments.

In addition to the above concerns regarding EPA's definition and application of PTW concentration thresholds, FMC has concerns regarding the RI Mechanistic Model that was used to establish the PTW concentration threshold (and preliminary remediation goals [PRGs]) for key contaminants of concern (e.g., Total PCBs). In prior comments that FMC provided to EPA regarding the RI Mechanistic Model (FMC 2012), FMC documented that the model is not sufficiently robust and, along with other problems, makes erroneous assumptions regarding fish exposure. For example, the RI Mechanistic Model assumes that all fish are exposed to the bank-to-bank, site-wide average sediment concentration of a contaminant (i.e., the average across the near-shore areas and the navigation channel throughout the study area). In reality, as determined in a radio-tagging study performed in the Lower Willamette River (LWR) and recognized by EPA in its 2009 comments to the Lower Willamette Group (LWG) regarding parameterization of the RI Mechanistic Model (Pribyl et al. 2005, LWG 2009), fish are more likely to feed in near-shore areas that contain higher contaminant sediment concentrations. As a result of these flaws and other issues described in FMC's prior comments (FMC 2012), FMC concluded that the RI Mechanistic Model produces PRGs that are biased low.

Despite FMC's prior comments, EPA has subsequently chosen to continue using the RI Mechanistic Model without incorporating any of the corrections FMC demonstrated were necessary in 2012. Applying the unamended RI Mechanistic Model, EPA has developed an erroneous and burdensome PCB PTW threshold. Consequently, FMC has undertaken a more comprehensive review and re-evaluation of the RI Mechanistic Model (see attached FMC FWM report, cited as FMC 2016 herein). As part of this evaluation, FMC performed the following tasks:

- Developed a stochastic (probabilistic) food web model (FWM) using the same equations as the RI Mechanistic Model.
- Calibrated the FWM for Total PCBs by running the stochastic model 1 million times:
    - Input the same initial distributions and point values as the RI Mechanistic Model for environmental parameters (except sediment organic carbon content), general biological parameters, species-specific biological parameters, species-specific dietary parameters and chemical-specific parameters (except sediment concentration).
    - Characterized the sediment concentration based upon the near-shore (i.e., non-navigation channel) spatially-weighted average concentration (SWAC).
    - Characterized the sediment organic carbon content based upon near-shore sampling data.
    - Judged model performance based upon a comparison of the model output to the geometric mean concentration of PCBs measured in invertebrate and fish tissue samples (geometric statistics are typically used in evaluating food web models to account for the

fact that measured tissue concentrations are not normally distributed [Arnot and Gobas 2004]).

- Calibrated the FWM for Total DDX by running the stochastic model for 100,000 iterations:
  - Input the calibrated non-chemical specific parameters from the PCB analysis.
  - Input the same initial distributions and point values as the RI Mechanistic Model for DDX-specific parameters (except sediment concentration).
  - Characterized the sediment concentration based upon the near-shore (i.e., non-navigation channel) SWAC.
  - Judged model performance based upon a comparison of the model output to the geometric mean concentration of DDX measured in invertebrate and fish tissue samples.
- Confirmed that the calibrated FWM performs better (i.e., more accurately predicts measured invertebrate and fish tissue concentrations) than the RI Mechanistic Model on a site-wide scale for Total PCBs and Total DDX, and on a smaller scale (1-mile for smallmouth bass) for Total PCBs.
- Used the calibrated FWM to calculate that a PCB sediment concentration of over 500 ppb is associated with a fish tissue concentration equivalent to a $1x10^{-3}$ cancer risk under EPA's subsistence fisher exposure pathway, which forms the basis for EPA's PCB PTW threshold.

In conclusion, the FMC FWM was developed to characterize the actual exposure of biota at Portland Harbor to contaminated surface sediments more accurately than the RI Mechanistic Model. In addition, the FWM was more robustly calibrated, with 1 million iterations of valid input parameter values being run to identify the optimum parameter values for Total PCBs (in contrast, the RI Mechanistic Model was calibrated with only 9,982 valid model iterations for PCBs). The fact that these steps have resulted in a calibrated model for both Total PCBs and Total DDX that more accurately predicts measured average fish tissue concentrations compels EPA to reconsider its use of the RI Mechanistic Model to derive the PCB PTW concentration threshold. As FMC recommended to EPA in 2012, and as set forth in the attached report (FMC, 2016), FMC has developed a far more robust FWM that more accurately associates sediment and fish tissue concentrations that should now form the basis of EPA's PTW evaluation.

While FMC fundamentally disagrees with EPA's approach to characterizing the PCB PTW threshold based upon the indirect fish consumption exposure pathway and applying it on a point-by-point basis, application of FMC's FWM to re-define the PCB PTW threshold at 500 ppb would profoundly alter EPA's formulation and evaluation of the remedial alternatives in the FS Report and re-configure what the Proposed Plan would identify as the preferred remedy. The largest impact would be on the size of delineated Sediment Management Areas (SMAs) and corresponding volumes to be dredged and/or areas to be capped. Clearly these factors have tremendous implications with regard to the scope of the proposed remedy and EPA's remedial cost estimate. Given the significance of these findings, EPA should thoroughly review FMC's attached FWM Report (FMC, 2016), consider the technical merits, and use it to supplant the RI Mechanistic Model in defining the PTW concentration threshold for PCBs at the Portland Harbor site.

2) **EPA's interpolation method for developing RAL and PTW contours results in an inaccurate depiction of surface sediment concentrations. Additionally, EPA's approach is inconsistent with the interpolation method used to characterize spatially weighted average concentrations (SWACs) of chemicals in surface sediment within the RI Mechanistic Model. Consequently, EPA's approach to producing RAL and PTW surface sediment contours is in conflict with the approach that EPA used to develop PRGs and PTW threshold concentrations for key contaminants of concern (COCs) (e.g., Total PCBs).**

PTW and RAL contours for focused COCs are depicted respectively in Figure 3.2-3 and Figures 3.4-7 through 3.4-12 of the draft final FS Report. EPA indicates that these contours were developed by applying the Natural Neighbors geostatistical technique to interpolate the surface sediment sampling data for focused COCs across a 10-foot by 10-foot regularly spaced grid. However, upon further review, it is apparent that EPA did not apply this interpolation method across the entire study area. Instead, EPA first separated the surface sediment data for each COC into three distinct data sets based upon geographic location. Specifically, the data were divided as follows:

- Samples collected along the western side of the river (i.e., between the western riverbank and the western navigation channel boundary);
- Samples collected in the navigation channel; and
- Samples collected along the eastern side of the river (i.e., between the eastern riverbank and the eastern navigation channel boundary).

EPA developed PTW and RAL contours within each of these three areas by interpolating only the sample data collected from that area. Also, the boundaries of each area were used to confine the contours (e.g., contours developed using sample data collected in the navigation channel were not allowed to extend outside of the navigation channel). As discussed below, EPA's approach is problematic for a variety of reasons.

Figure 1 recreates EPA's RAL contours for 2,3,7,8-TCDD (TCDD) near River Mile (RM) 9. In contrast, Figure 2 depicts the RAL contours that would be generated if the entire TCDD surface sediment dataset was interpolated across the entire study area. TCDD surface sediment sample locations from EPA's FS Report Database are also shown on Figures 1 and 2. A comparison of the two figures highlights several deficiencies in EPA's approach:

1) EPA's RAL contours are artificially cut off at the navigation channel boundary, and
2) EPA's near-shore RAL contours artificially extend for long distances because nearby samples collected in the navigation channel are not used to "bound" the contours more realistically.

The artificial cut-off of RAL contours at the navigation channel boundary is evident throughout Figures

3.4-7 to 3.4-12 of the draft final FS Report. For example, in Figure 3.4-7 (PCB RAL contours), near the Burgard Yard between RM 3.5-4, a contour greater than 50 ppb lies within the navigation channel and is entirely distinct from a contour above 50 ppb on the eastern shoreline. Furthermore, this eastern shoreline contour extends just beyond RM 4.5, but remains unrealistically bound by the navigation channel. Such contouring is evident throughout the Site and is contrary to any known dispersion process.

The fundamental flaw in EPA's PTW and RAL contouring approach is that it does not provide an accurate delineation of surface sediment concentrations across the study area. Consequently, the areas identified for remediation in the draft final FS Report cannot be considered reliable. EPA's technology assignments and cost estimates are based on these delineations and similarly cannot be relied upon. Figures 1 and 2 attached hereto illustrate the radically different extent of a potential SMA at RM 9 for a single COC, namely TCDD, when contours are bound by the navigation channel (Figure 1) versus when contours are developed using all sample data (Figure 2). EPA's flawed contouring approach also creates substantial obstacles to accurately identifying the source or sources responsible for the skewed dispersion patterns shown in the FS Report figures. Beyond its effects in undermining EPA's evaluation of the remedial alternatives, the skewed contouring also will confound development of an appropriate sampling plan for the Remedial Design. Relying on EPA's flawed contouring approach, which was never described, much less justified, in the FS Report, causes multiple errors: 1) it affects the delineation of SMAs throughout the Site and thereby subverts the FS cost estimates; 2) it unnecessarily complicates the Remedial Design process ; and 3) it undermines allocating remedial action requirements and costs to responsible parties.

It is also important to note that EPA's PTW and RAL contouring approach is inconsistent with the approach used by EPA to develop PRGs and PTW thresholds for key COCs. In establishing the relationship between PCB surface sediment and fish/invertebrate tissue concentrations in the RI Mechanistic Model, Natural Neighbors interpolation was performed on the entire surface sediment data set in order to calculate a bank-to-bank, site-wide SWAC. This bank-to-bank, site-wide SWAC was a key input to developing the RI Mechanistic Model, which was subsequently applied to derive PRGs and PTW thresholds. While FMC has raised fundamental technical issues regarding the validity of the RI Mechanistic Model (*see* Comment 1), it is inappropriate for EPA to develop PTW and RAL contours using an interpolation method that differs from that used in the RI Mechanistic Model to develop PRGs and PTW thresholds for key COCs.

Finally, it would appear that EPA has adopted its approach to identifying PTW and RAL contours in order to provide a worst-case estimate of the extent to which near-shore areas contain sediment concentrations in excess of PTW/RAL thresholds. Thus, EPA's primary focus appears to be on potential risks associated with exposure to near-shore sediments. It is noteworthy that the calibrated FWM developed by FMC (discussed in Comment 1) is focused upon establishing a relationship between fish/invertebrate tissue concentrations and near-shore sediment concentrations. While FMC fundamentally disagrees with EPA's approach to characterizing the PCB PTW threshold based upon the indirect fish consumption exposure pathway and

applying the threshold on a point-by-point basis, EPA's focus on near-shore sediment further in fact validates the position that FMC's FWM is better suited to this task than the RI Mechanistic Model.

In conclusion, the SMAs defined in the draft final FS would be vastly different if 1) a concentration of 500 ppb was used to define the PCB PTW threshold (Comment 1) and 2) the unconstrained surface sediment data were used to develop PTW/RAL contours (Comment 2). EPA's reliance upon an unjustified PTW/RAL contouring methodology and a flawed food web model that defines a low-biased PTW concentration threshold for PCBs (which defines the remedy in many SMAs) creates an unacceptable degree of uncertainty into the scope and cost of the proposed remedy that precludes rational application of the NCP remedy selection criteria.

3) **EPA's FS database contains composite subsurface sediment samples. Use of those sample data to develop dredge volume estimates is inappropriate**

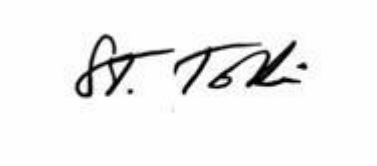
According to Section 3.4.8.3 of the draft final FS Report (Volume Estimates), necessary dredge volumes were estimated by performing a Natural Neighbors geostatistical interpolation of the existing subsurface sediment data. Based on the results of this interpolation, each 10 foot-by 10 foot surface grid was assigned a depth to threshold, corresponding to the deepest sediment sample with concentrations exceeding RALs. The volume of contamination in each SMA was then calculated by summing the volumes (area of each grid multiplied by its interpolated depth to threshold) of the grids in each SMA.

To support its discussion of dredge volume estimates in Section 3.4.8.3 of the draft final FS Report, EPA references core profiles showing the depth of contamination for the focused COCs (Figures 3.4-26a-v through 3.4-31a-h). FMC notes that these core profiles include data associated with LWG's Sediment Chemical Mobility Testing sampling event performed from August 18 through September 5, 2008 (Task No. B01-01-78B_MobSE). However, as described in the report produced for this task (Integral 2009), these data are associated with composite sediment samples comprised of sample increments collected from multiple, geographically distinct locations of the river. In the database each composite sample was arbitrarily assigned location coordinates at the approximate center of the locations from which the sample increments were collected. As such, these data are not representative of actual concentrations detected at the cited locations.

One example is sampling assigned to Core LWMC19, located directly alongside the downstream end of the side launchway of the Gunderson facility as depicted in Figure 3.4-26r of the draft final FS Report. The Figure shows a Total PCB concentration in excess of 1 ppm from a depth of 0 to 386 cm at this location. However, this sample was collected as part of the Sediment Chemical Mobility Testing sampling event and is actually a composite of four sample increments that were collected at separate points along the

Gunderson shoreline (see Figure 2-1i of Integral 2009). The depicted location of this sample in Figure 3.4-26r of the draft final FS Report is, in reality, the center of the four locations at which sample increments were taken. Consequently, it is inappropriate to use data for this sample, and data for other samples collected during this event, to determine dredge volumes. Use of these samples in EPA's analysis potentially results in significant inaccuracies in EPA's dredge volume estimates and associated cost estimates.

Sincerely,



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Attachment – FMC FWM Report

REFERENCES

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Integral. 2009. Portland Harbor RI/FS – Draft Sediment Chemical Mobility Testing Data Report. August 11, 2009.

LWG. 2009. LWG Responses to Regulatory Comments on the May 29, 2009 Version of the Bioaccumulation Model. Electronic document titled "2009-05-29_Bioaccum modeling report comment response table.doc".

Pribyl AL, Vile JS, Friesen TA. 2005. Population structure, movement, habitat use, and diet of resident piscivorous fishes in the Lower Willamette River. In: Friesen TA, ed, Biology, behavior, and resources of resident and anadromous fish in the Lower Willamette River. Final report of research, 2000-2004. Prepared for City of Portland. Oregon Department of Fish and Wildlife, Clackamas, OR, pp 139-183.

Windward. 2015. Portland Harbor RI/FS – Revised Draft Bioaccumulation Modeling Report. June 19, 2015.

Figure 1

Recreation of EPA's RAL Contours for 2,3,7,8-TCDD Near RM-9 on Western Shoreline

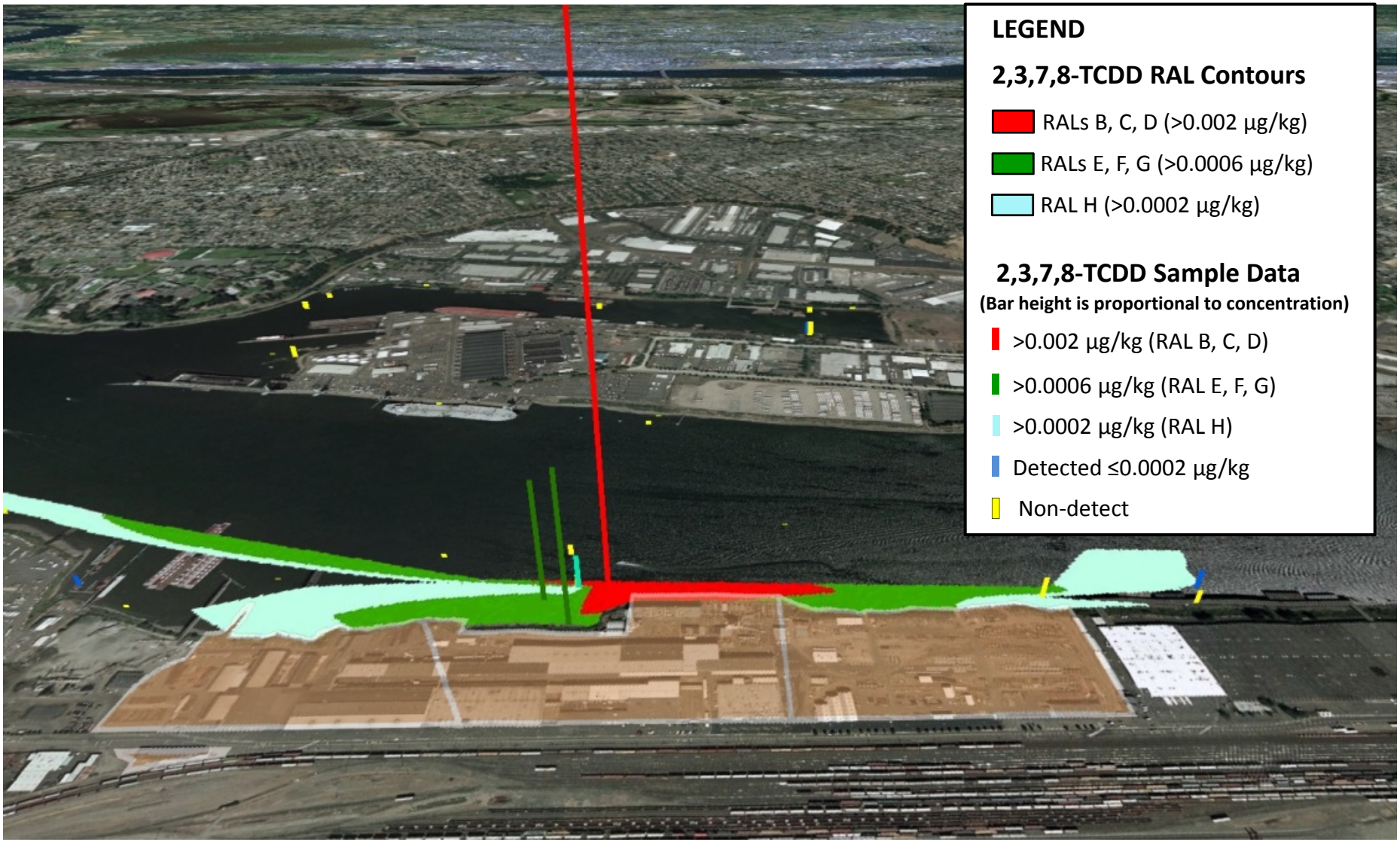

Figure 2
RAL Contours for 2,3,7,8-TCDD Near RM-9 on Western Shoreline Using Site-Wide Data